Space Weather Technical Forecast

Issued on Wednesday, 22 May 2024 at 11:58 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Please note: On the 22 May between 1400 UTC and 1900 UTC, a significant data outage at NOAA SWPC is expected which will impact most of our observational data feeds and some models. We may receive data intermittently through that period. MOSWOC service will continue on contingency. Alerts and warnings will be sent using alternative data, if available. The planned data outage may be postponed in the event of significant space weather.

Space Weather Forecast Headline: Isolated M-class flares likely throughout. Slight chance G1 Minor Storm day 3-4 (24-25 May) from CH39/- fast wind arrival.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: The activity was Moderate with an M2.3 flare at 22/0404 UTC from AR3683, which has recently crossed the south-west limb. An impulsive M1.5 was also observed from AR3679 at 22/0313 UTC. There are eight sunspot regions on the disc. Most notable is AR3679 in the southwest, which has maintained a small delta-configuration to the north of its leader. Its trailer spots, consisting of a further bipolar pair, also show some very slightly mixed polarities within their local intermediate region. The other larger spot is AR3685 nearing the south-centre disc, however this appears to be a mature region with little ongoing development, beyond the emergence of a small bipolar pair of spots on its southern periphery.

No Earth-directed CMEs were observed in available imagery. However, a large filament currently lies over the southeast quadrant. It looks unstable and will need to be monitored in case of eruption.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 have been indicative of ongoing slow wind conditions. The solar wind speed was around 380-420km/s initially but has been generally declining towards background levels since 22/0400 UTC to reach 340 km/s. Density has remained well below average. Interplanetary Magnetic Field (IMF), Bt, was weak, at 5-8nT, with the north-south component, Bz, fluctuating between +/-7nT while favouring a positive (northward) orientation. Phi angle was positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) was very slightly above background at first, likely due to a far-sided eruption on 20 May, perhaps AR3664, but have eased to normal background. High energy electron flux (greater than 2MeV) observed by GOES-16 was mainly Moderate, with a peak of 765 pfu at 21/1705UTC. The associated 24-hour fluence has remained below the Active threshold. Observed fluence at 22/0000 UTC was 2.27e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is likely to continue with isolated M-flares possible each day, and a slight chance of rising to High due to any X-class flares. These most likely from AR3679, or perhaps AR3685. Ex-AR3663 is also anticipated to return to the northeast limb day 3-4 (24-25

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May) however it is uncertain how much this region has survived its transit across the far-side.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs. Slightly elevated to background solar winds are expected to persist until day 3-4 (24-25 May), before the onset of any fast wind enhancement from the southward extension of northern hemisphere CH39/-. The strength and timing of any enhancement is low confidence, however. Mainly Quiet activity is expected with only isolated Unsettled intervals, but likely rising to Active with a slight chance of G1 Minor Storm intervals from any coronal hole enhancement, most likely day 4 (25 May).

Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at background levels, with only a very slight chance of enhancement given any strong flares from the regions on the southwest disc. High energy electron flux is forecast to continue Moderate, with a chance of rising to High at diurnal maximum. However the associated 24 hour fluence is expected to remain below the active threshold. Any fast wind onset on day 3-4 (24-25 May) is also likely to bring a drop-out of observed flux, likely easing to background.

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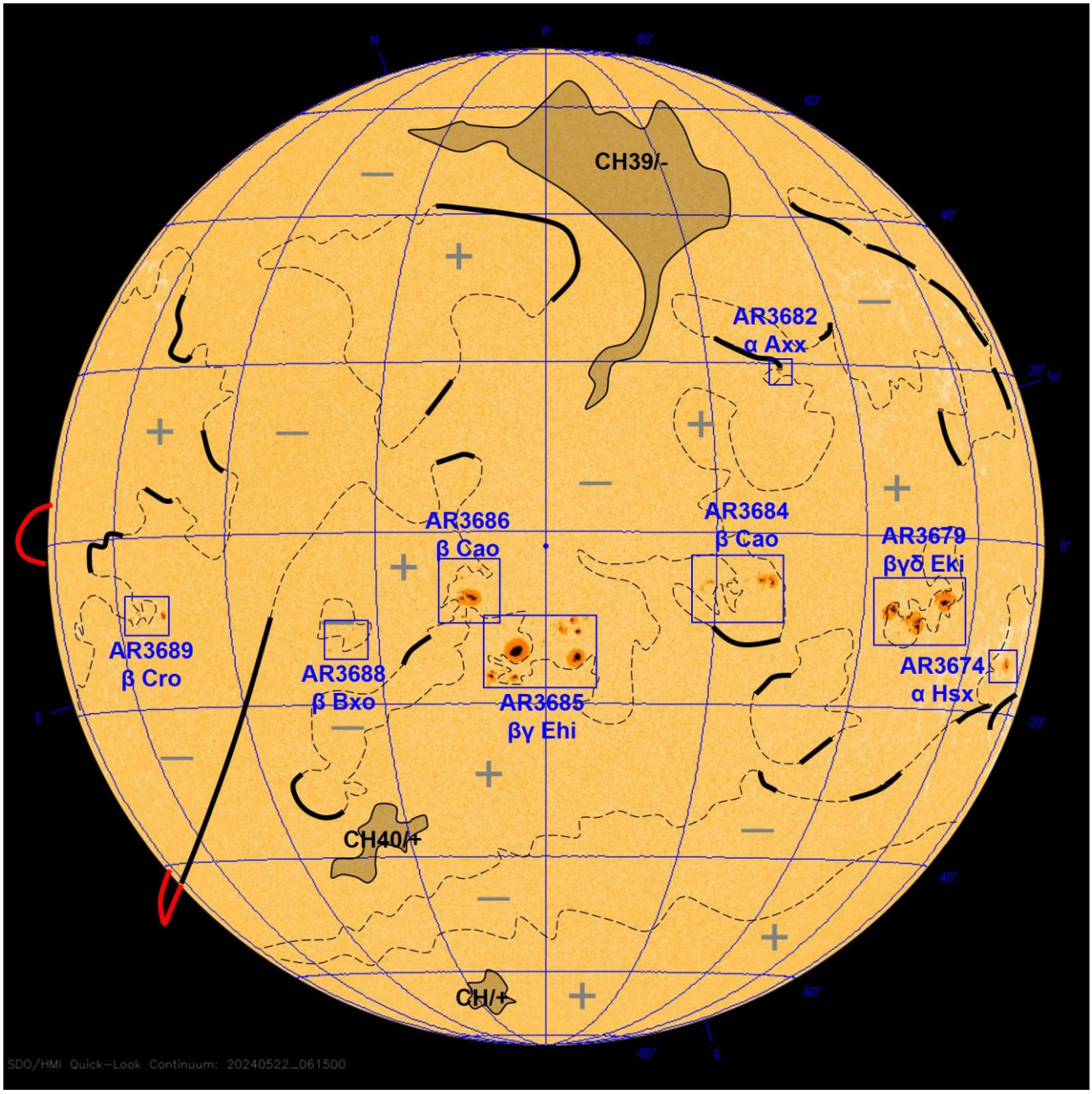
Figure 1. Solar Analysis Valid 22/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs.

Solar winds are currently slightly elevated to background and expected to persist at this level until the onset of the next fast wind enhancement, likely from CH39/- later on day 3 (24 May) or day 4 (25 May). This is a large northern hemisphere feature, with a narrow southern extension into the solar mid-latitudes, and was not present on the previous rotation. Coupled with the disfavoured time of year for strong connections to coronal hole fast winds (Russel-McPherron effect), and the limited response currently featured in the MOSWOC Enlil model, there is significant uncertainty for the timing and strength any notable enhancement.

However, this does bring a chance of solar winds rising to around 500-600 km/s, and any negative (southward) IMF would then bring the likelihood of a spell of Active geomagnetic activity from day 3 (24 May), with a slight chance of G1 Minor geomagnetic storms day 4 (25 May). Otherwise, mainly Quiet conditions expected with a chance of isolated Unsettled intervals.

A large filament currently lies over the southeast quadrant. It looks unstable and will need to be monitored in case of eruption.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	10	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity – Earthbound Coronal Mass Ejections

Nil.

Figure 2: MOSWOC Enlil, showing very little enhancement at Earth through the period.

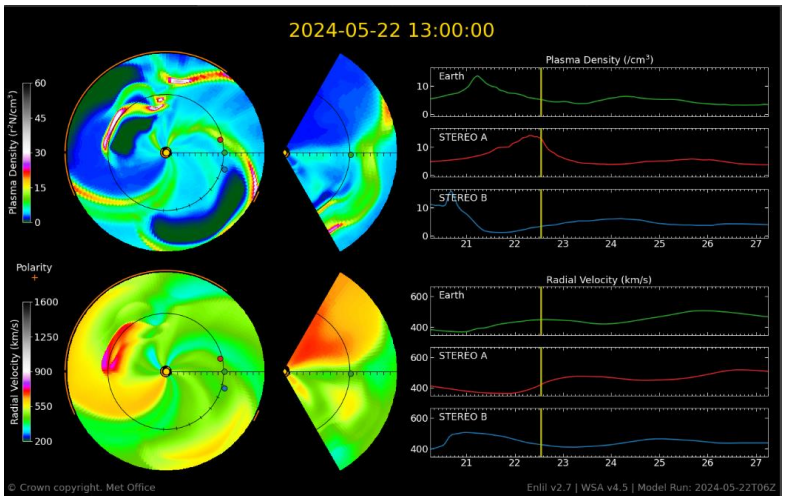

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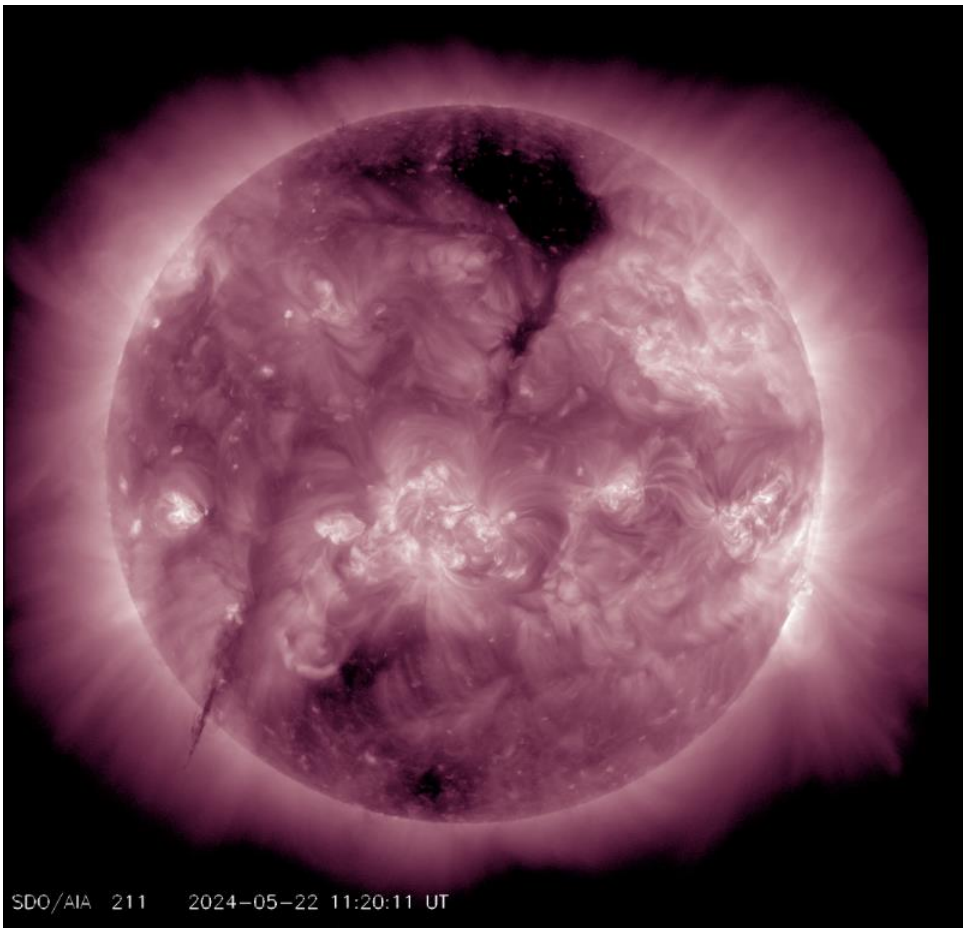
Figure 2b: Latest SDO aia-211 showing large northern coronal hole



Radio Blackouts - X-Ray Flares:

Moderate activity is likely to continue with isolated M-flares possible each day, and a slight chance of rising to High due to any X-class flares.

There are eight sunspot regions on the disc. Most notable is AR3679 in the western central part, which has maintained a small delta-configuration to the north of its leader. Its trailer spots, consisting of a further bipolar pair, also show some very slightly mixed polarities within their local intermediate region. The other larger spot is AR3685 nearing the south-centre disc, however this appears to be a mature region with little ongoing development, beyond the emergence of a small bipolar pair of spots on its southern periphery. The other regions are currently smaller, simpler and largely stable.

Later on day 3 and into day 4 (24-25 May) the return of ex-AR3663 is expected onto the northeast limb. It was the source of five X-flares (peaking X4.5) before leaving the west limb on 09 May and has maintained some kind of activity on far-sided products. However, it is not possible to know how much the group has changed whilst migrating across the Sun's far-side.

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X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	Yes	75	70	60	60
Very Active	**R3 to R5 X Class**	No	10	10	5	5

Figure 3: Latest GOES 18 X-Ray Flux

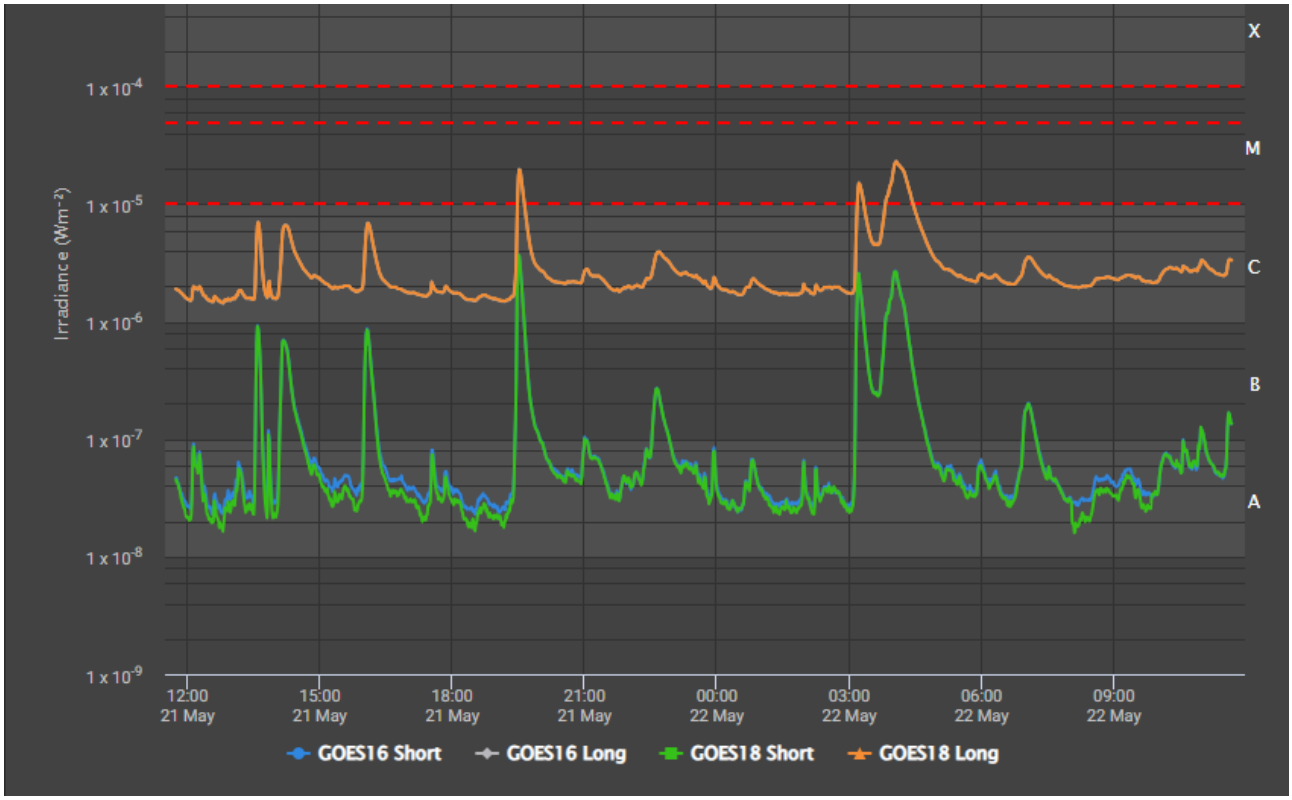

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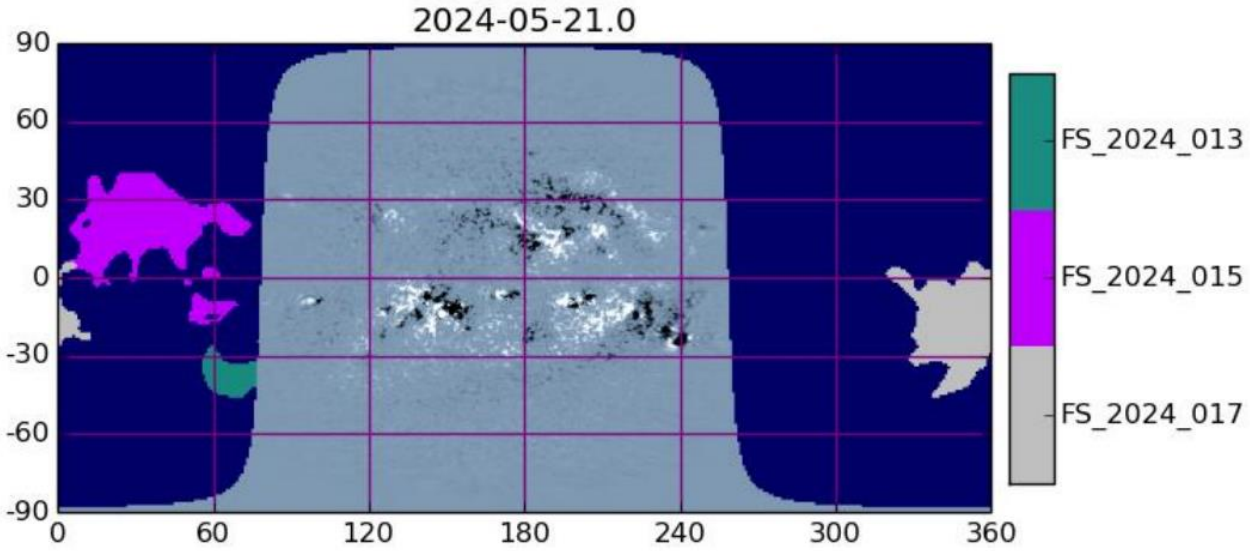
Figure 3b: Far-side helioseismic returns (courtesy of jsoc.stranford.edu) showing potential returning regions, likely ex AR3663 and AR3664.



Solar Radiation Storms - (High Energy Protons):

Observed proton flux has been very slightly above background since early on 20 May, likely due to the far-side eruption, probably from AR3664, with an associated halo CME observed moving away from Earth. These levels have since eased to background, with only a slight chance of seeing further enhancement from any of the near-sided sunspot regions. This most likely from AR3679 if any further development occurs.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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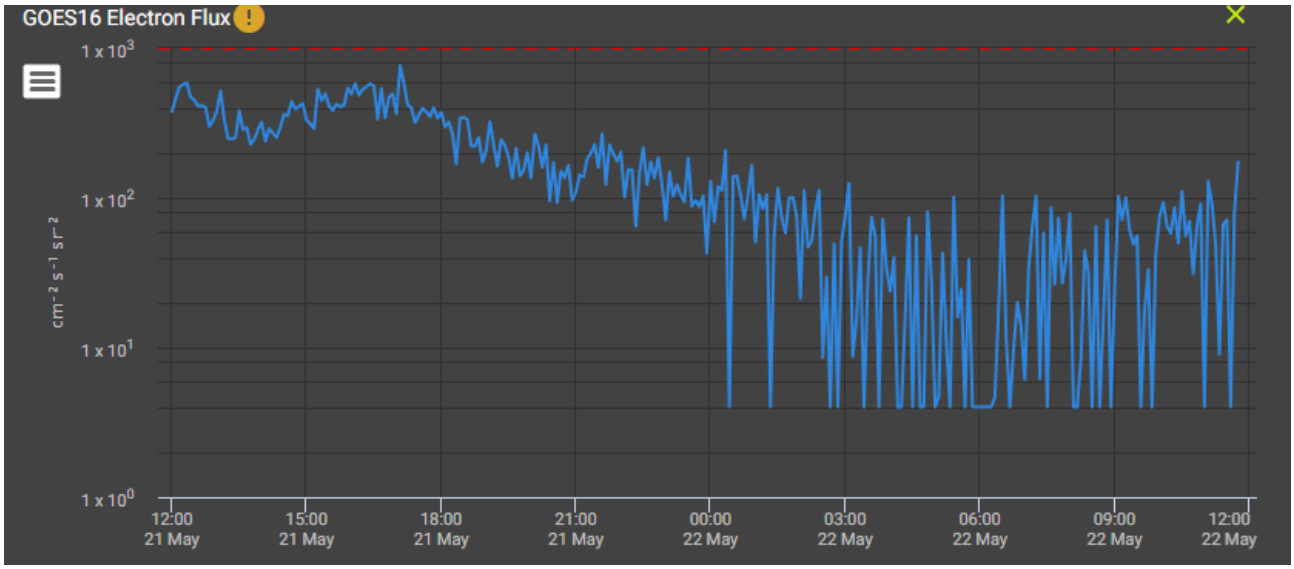
High Energy Electrons Event (≥ 2MeV):
High energy flux, as observed by GOES-16, has continued on a slow upward trend as the solar wind environment eased, with an increasing chance of reaching High flux at periods of diurnal maximum. This trend is expected to continue until day four (25 May), when the arrival of any fast wind from southern extension of the northern coronal hole CH39/+ is likely to subdued the observed values at GEO.

While a slow upward trend is expected to the associated 24 hour fluence, this is now expected to remain below the Active threshold, likely peaking on day 3 (24 May), before declining again as a consequence of any HSS onset. This upward trend is indicated by MOSWOC REFM through day 1 (22 May), but then likely decreases the observed flux too quickly beyond T+24. However, this does support below Active fluence persisting.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: GOES 16 >2MeV Electron flux and associated Fluence with REFM



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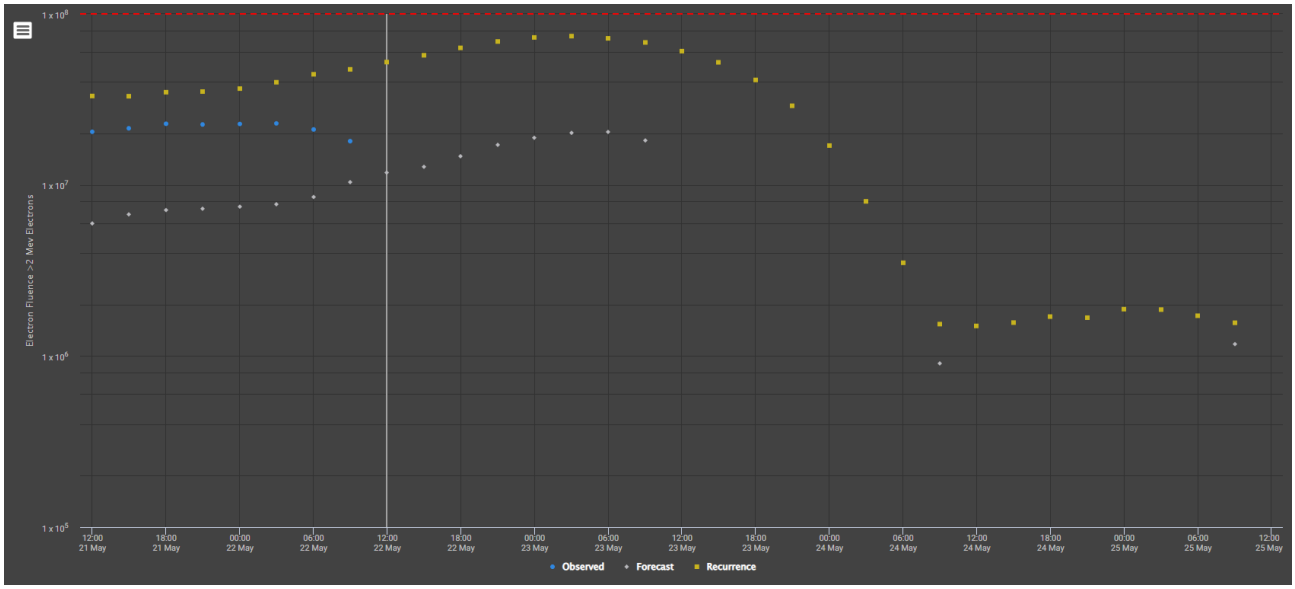

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